California Air Resources Board's
Emissions Inventory Series

Volume 1 Issue 8

# On-Road Activity

## County Specific Estimates of Population and Travel

• The On-Road Emissions Inventory is calculated as the product of Population, Activity and an Emission Rate.

• In this instance, the term "Population" refers to vehicle population and "Activity" includes the miles per day driven by the fleet (VMT), the speed at which these miles are driven (Speed Distribution) and the number of trips per vehicle per day.

• The activity estimates used in the on-road inventory are county or sub-county specific and are provided by regional planning agencies. Through the use of Travel Demand Models, these local agencies are able to predict the number of trips, miles and speeds which are applicable to their areas.

• In the absence of input from Metropolitan Planning Organizations (MPOs) or Councils of Governments (COGs), activity is estimated by the ARB.

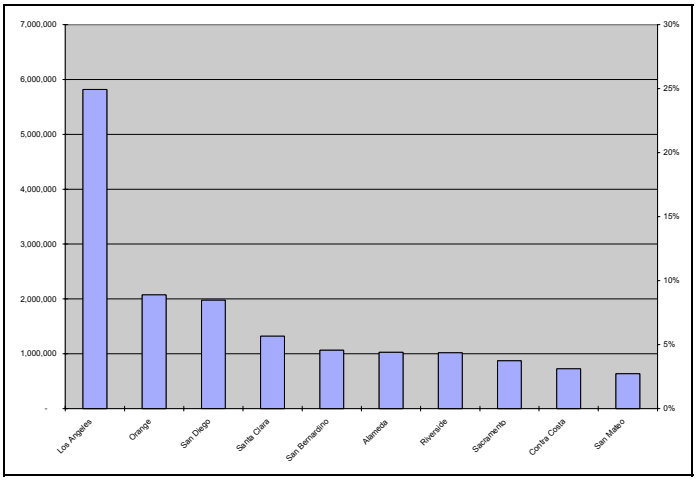
### • Vehicle Miles of Travel

• VMT can be calculated as the product of Vehicle Population, Mileage Accrual Rate. For example, if 10,000 cars travel 10,000 miles per year, their VMT is 100,000 miles/year. Even though most major metropolitan areas provide VMT information to ARB, the inventory maintains the relationship between VMT, Population and Mileage Accrual Rates.

### Population

Vehicle registration data is obtained from the California Department of Motor Vehicles (DMV). This database is analyzed by ARB staff in order to sort the fleet according to motive power (the on-road inventory currently only reports emissions for vehicles powered by either gasoline, diesel or electricity), vehicle class (passenger cars, light-, medium-, and heavy-duty trucks, school buses, transit buses, motorcycles and motor homes), and age.

An analysis is also performed to determine the number of vehicles which are being operated although they are not currently registered. "Chronically Unregistered Vehicles", those that go for two year or more without renewing their registration, are not assumed to benefit from the California's I/M Program.




Top Ten California Counties with Highest Vehicle Populations

### Mileage Accrual Rates

Most gasoline powered vehicles are subject to California's I/M program. During the vehicle inspection, technicians record the vehicle's odometer reading. ARB staff routinely obtain this information from the Department of Consumer Affairs, Bureau of Automotive Repair to determine the average miles driven as a function of vehicle type and age. This analysis is performed on a county specific basis to reflect regional differences in travel.

A similar analysis is conducted for diesel vehicles using the Truck Inventory and Use Surveys (TIUS) performed by the Bureau of Census.

## AGE DISTRIBUTION

In previous version of EMFAC, the age distribution, the accounting of the number of vehicles by age in the fleet, was limited in years.

Prior to MVEI7G the passenger car distribution was truncated to 25 years with model years twenty and older evenly distributed into years 20 to 25.

This assumption lead to an overestimate of the benefits of fleet turnover in that a significant number of older (higher emitting) vehicles were assumed to retire from the fleet each year.

MVEI7G expanded the age distribution of passenger cars from 25 to 35 model years although other vehicle classes were still restricted to 25 years or less.

Beginning with EMFAC2000, the registration distribution of all vehicle classes were expanded to 45 model years with vehicles older than 45 included in the 45th year.

This change resulted in a higher emissions estimate for the on-road fleet but it highlighted the continuing significant contribution that older vehicles have on the overall inventory.

# COUNTY SPECIFIT ACTIVITY—QUICK FACTS

### Speed Distributions

Speed has a significant effect on exhaust emission rates. The on-road emission inventory uses "Speed Correction Factors" (SCFs) to adjust the basic emission rates.

In general, the SCFs are "U" shaped for passenger cars with higher emissions at both low and high extremes of speed.

As stated earlier, speed distributions, vehicle miles of travel by speed, are provided to ARB by local planning agencies for incorporation into the inventory models. VMT is reported in thirteen "bins" of five miles per hour, ranging from five to 65+ miles per hour.

The speed distributions are specific to the time of day and most agencies provide three or more daily distributions including morning peak, afternoon peak and off-peak travel. The on-road inventory spreads this data across 24 hours in order to provide hourly inventory estimates as well as daily summaries.

Most travel demand models are not concerned with vehicle class and therefore the provided speed distributions are applied to each class, that is motorcycles are assumed to have the same speed distribution as passenger cars.

The Southern California Association of Governments (SCAG) has recently a truck specific travel demand model and they provide ARB staff with separate truck specific VMT and Speed distributions. Buses have unique speed distributions based on in-field observations.

| County | Vehicle Population | Vehicle Miles of Travel | Trips | Miles Per Vehicle | Avg. Age of Pass Car Fleet |
|---|---|---|---|---|---|
| Alameda | 1,024,140 | 32,845,000 | 7,044,240 | 32.07 | 9.46 |
| Alpine | 1,459 | 41,000 | 10,245 | 28.10 | 13.43 |
| Amador | 34,300 | 1,149,000 | 236,407 | 33.50 | 10.98 |
| Butte | 154,625 | 4,496,000 | 1,049,330 | 29.08 | 11.37 |
| Calaveras | 42,043 | 1,209,000 | 287,640 | 28.76 | 11.69 |
| Colusa | 16,339 | 550,000 | 128,054 | 33.66 | 11.24 |
| Contra Costa | 722,827 | 23,780,000 | 4,787,070 | 32.90 | 11.24 |
| Del Norte | 19,079 | 565,000 | 129,864 | 29.61 | 9.12 |
| El Dorado | 136,295 | 3,763,000 | 920,317 | 27.61 | 11.17 |
| Fresno | 497,810 | 18,920,000 | 3,544,510 | 38.01 | 10.21 |
| Glenn | 22,606 | 685,000 | 170,128 | 30.30 | 11.62 |
| Humboldt | 104,811 | 3,194,000 | 723,918 | 30.47 | 11.41 |
| Imperial | 110,287 | 4,090,000 | 797,341 | 37.09 | 11.77 |
| Inyo | 19,822 | 565,000 | 141,693 | 28.50 | 11.83 |
| Kern | 438,223 | 18,352,000 | 3,140,824 | 41.88 | 9.94 |
| Kings | 69,631 | 3,114,000 | 487,927 | 44.72 | 10.16 |
| Lake | 54,339 | 1,545,000 | 371,316 | 28.43 | 12.37 |
| Lassen | 24,006 | 720,000 | 170,209 | 29.99 | 12.10 |
| Los Angeles | 5,811,255 | 197,059,000 | 39,896,020 | 33.91 | 9.36 |
| Madera | 79,635 | 3,104,000 | 558,435 | 38.98 | 10.68 |
| Marin | 219,190 | 6,652,000 | 1,461,010 | 30.35 | 9.32 |
| Mariposa | 17,492 | 487,000 | 118,776 | 27.84 | 15.37 |
| Mendocino | 77,726 | 2,363,000 | 544,515 | 30.40 | 11.73 |
| Merced | 139,000 | 6,439,000 | 973,145 | 46.32 | 10.77 |
| Modoc | 8,474 | 250,000 | 66,386 | 29.50 | 12.28 |
| Mono | 11,207 | 331,000 | 80,820 | 29.54 | 11.84 |
| Monterey | 264,684 | 11,158,000 | 1,832,550 | 42.16 | 10.15 |
| Napa | 102,916 | 3,000,000 | 704,039 | 29.15 | 10.25 |
| Nevada | 85,947 | 2,434,000 | 580,180 | 28.32 | 10.46 |

**Starts Per Vehicle Per Weekday as a function of Age**

| AGE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STARTS | 6.56 | 6.54 | 6.52 | 6.50 | 6.49 | 6.47 | 6.44 | 6.42 | 6.39 | 6.35 | 6.31 |
| AGE | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| STARTS | 6.26 | 6.22 | 6.17 | 6.13 | 6.08 | 6.04 | 6.00 | 5.95 | 5.91 | 5.87 | 5.81 |

# COUNTY SPECIFC ACTIVITY—QUICK FACTS

| County | Vehicle Population | Vehicle Miles of Travel | Trips | Miles Per Vehicle | Avg. Age of Pass Car Fleet |
|---|---|---|---|---|---|
| Orange | 2,071,490 | 65,359,000 | 1,4058,600 | 31.55 | 10.46 |
| Placer | 207,144 | 6,507,000 | 1,419,279 | 31.41 | 8.47 |
| Plumas | 22,456 | 667,000 | 158,882 | 29.70 | 9.44 |
| Riverside | 1,014,703 | 42,170,000 | 6,890,676 | 41.56 | 11.91 |
| Sacramento | 869,210 | 29,793,000 | 6,219,570 | 34.28 | 9.30 |
| San Benito | 37,104 | 1,499,000 | 257,993 | 40.40 | 9.48 |
| San Bernardino | 1,064,007 | 39,152,000 | 7,298,540 | 36.80 | 9.99 |
| San Diego | 1,973,250 | 73,908,000 | 13,183,400 | 37.45 | 9.61 |
| San Francisco | 437,472 | 12,662,000 | 3,043,220 | 28.94 | 9.19 |
| San Joaquin | 362,691 | 14,940,000 | 2,521,720 | 41.19 | 9.25 |
| San Luis Obispo | 195,165 | 5,974,000 | 1,323,380 | 30.61 | 10.20 |
| San Mateo | 634,302 | 21,678,000 | 4,284,050 | 34.18 | 9.78 |
| Santa Barbara | 298,436 | 9,586,000 | 2,044,750 | 32.12 | 7.74 |
| Santa Clara | 1,319,390 | 43,102,000 | 8,829,960 | 32.67 | 10.27 |
| Santa Cruz | 199,299 | 5,468,000 | 1,348,170 | 27.44 | 10.73 |
| Shasta | 135,553 | 4,068,000 | 922,781 | 30.01 | 10.73 |
| Sierra | 3,533 | 99,000 | 25,336 | 28.02 | 11.10 |
| Siskiyou | 44,399 | 1,281,000 | 314,852 | 28.65 | 11.74 |
| Solano | 281,054 | 9,172,000 | 1,882,120 | 32.63 | 12.21 |
| Sonoma | 374,197 | 11,819,000 | 2,556,510 | 31.58 | 9.42 |
| Stanislaus | 304,950 | 10,549,000 | 2,144,620 | 34.59 | 10.52 |
| Sutter | 60,658 | 1,921,000 | 428,324 | 31.67 | 10.43 |
| Tehama | 42,431 | 1,279,000 | 291,800 | 30.14 | 10.41 |
| Trinity | 12,831 | 354,000 | 9,039 | 27.59 | 10.81 |
| Tulare | 235,785 | 8,903,000 | 1,683,640 | 37.76 | 11.36 |
| Tuolumne | 50,255 | 1,419,000 | 342,308 | 28.24 | 13.16 |
| Ventura | 583,783 | 15,327,000 | 3,959,170 | 26.25 | 11.52 |
| Yolo | 118,280 | 4,482,000 | 865,625 | 37.89 | 9.26 |
| Yuba | 42,304 | 1,278,000 | 292,588 | 30.21 | 9.67 |
| **Statewide** | | | | | **11.58** |

| AGE | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STARTS | 5.74 | 5.68 | 5.59 | 5.48 | 5.36 | 5.22 | 5.06 | 4.90 | 4.74 | 4.59 | 4.47 | |
| AGE | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 |
| STARTS | 4.38 | 4.32 | 4.26 | 4.20 | 4.14 | 4.08 | 4.02 | 3.96 | 3.90 | 3.84 | 3.78 | 3.72 |

### Trips and Starts

The number of trips taken by vehicle each day is also provided to the ARB by regional planners as an output of travel demand models. Traditionally, a trip is defined as travel from an origin to a final destination.

However, because a vehicle's emission are elevated during starts, the on-road inventory must account for every key-on event. Short trips like shuffling vehicles in a driveway or moving from one parking spot to another in a strip mall are often forgotten on surveys.

The inventory currently carries an estimate of starts per vehicle per day which is significantly higher than the trip estimates provide by regional planners. The estimate used in the inventory is based on both instrumented vehicle data and travel survey data.

The results of this analysis show a declining number of starts per vehicle per day as the vehicle ages from a high of 6.56 when the vehicle is new to 3.72 for vehicle that live to be 45 years old.

### Inactivity

While estimates of activity are important in assessing emissions from motor vehicles, inactivity can be just as important.

Evaporative hydrocarbons are emitted both when cars are being driven and when they are inactive. How long a vehicle sits also affects the magnitude of subsequent starts. For these reasons, the on-road inventory maintains a "Time-Off" profile which is based on instrumented vehicle data.